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Pulpless Teeth and their Treatment.

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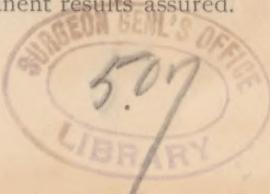
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IT is doubtful if dental literature presents another subject on which so much has been written with so great diversity of views as that of pulpless teeth. This is equally true whether as regards the description of the conduct of operations for the prevention of possible lesions, or the prescription of remedial treatment for the cure of existing troubles.

As almost universally accepted principles govern these matters, it is in the details of methods of procedure and therapeutics that these diverse opinions are found to exist. That admitted uncertainty or questionable positiveness to some extent characterize their discussion in almost every case, is evidenced by the text-books of our profession, and by its periodical literature and clinical reports.

A general contemplation of the subject under these circumstances is at times apt to be somewhat confusing as well as surprising, when we see such expressed divergence of opinion coming from those most eminent as practitioners. In view of these facts, therefore, in presenting before a body such as this a paper on pulpless teeth, which must necessarily discuss so many disputed points, I feel conscious that I have undertaken a difficult task. I will not assume to be able to enlighten you in an extraordinary degree, or to entirely harmonize your opinions. I shall endeavor to present for your consideration, discussion, and criticism, an intelligible conception of the subject, based as much as possible on science instead of empiricism, and practical experience rather than theory. I shall hope thus to assist in arriving at conclusions which will be ultimately universally recognized as correct in surgical procedures and most suitable in therapeutic treatment.

A pulpless tooth is understood to be a tooth with a non-vital pulp, or one from which the pulp has been removed, with consequent loss of vitality of the dentine. Respecting the remaining structures of such teeth, we have one of two conditions presented: the first where the vitality of the entire cementum is retained, the other with non-vitality of a part of the cementum on the side of the root, or of the portion constituting the apex, through the action of devitalizing agents or the presence of some lesion. Independent of other pathological conditions present, according to the degree of existing vitality as contributed by the connective tissue, the pericementum, favorable effects of treatment may be expected and permanent results assured.



The treatment of pulpless teeth or roots, for the prevention of future trouble or in connection with the cure of existing lesions, consists in as thorough a performance as possible of the following operations :

First, removal of the contents of the root-canals.

Second, disinfection of the root-canals and dentine, and the establishment of permanent aseptic conditions by mummification of the contents of the tubuli.

Third, closure of the apical foramen.

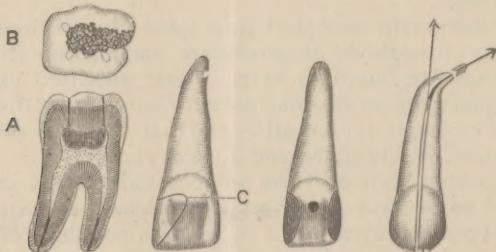
Preparation of Root-Canals.—A knowledge of the usual positions, forms, and variations of the roots and canals in the different teeth is essential for a generally successful performance of this operation, which is greatly facilitated by obtaining direct access to the root-canal by a proper removal of the tooth-structure. This in a lower molar is illustrated in section in Fig. 1, A. The slot in the occluding surface, it will be seen, is sufficiently extended to give direct access to the canals of both roots; an approximal decay requires similar extension (B). In the incisors enough of the palato-approximal wall

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.



should be removed to allow instruments to be used with the least possible curve, as shown at C, Fig. 2. Should this, in the opinion of the operator, involve too great a loss of tooth-structure, a small hole can be drilled in the palatal side, as seen in Fig. 3, and direct access to the canal thus obtained. The drilling of holes such as this is best confined to centrals, as if made in laterals and both approximal sides decay, the palatal wall is seriously weakened by the loss of so much of its structure, as shown in Fig. 3. In molars, when cervical decay of moderate extent involves the vitality of the pulp, and the contour of the coronal section is only slightly encroached upon, an independent entrance to the pulp-cavity had best be made in the center of the occluding surface for the treatment of the root-canal, the cervical cavity being filled separately.

The principles here outlined can also be applied to cuspids and bicuspids. In crown-work on the anterior teeth, the removal of the coronal section directly exposes the pulp-cavity. In preparing bicuspids and molars for all-gold crowns, the leveling of the occluding surface and removal of a portion of the side most involved by decay should be preliminary.

A proper opening having been made, any remaining portion of the pulp is removed with broaches. A few fibers of cotton should be twisted around the serrated portion of the broach, to allow of easy

removal in case of breakage. The canals are then, guided by frequent explorations with a fine probe, carefully enlarged with Gates-Glidden drills. At least three sizes, large, medium, and small, of drills each for the right angle and the direct hand-piece, are required. Very little, if any, pressure should be put upon them when in motion, as they will move forward sufficiently of themselves. Under pressure the formation of a false passage in a curved root is possible, or the small drill might be broken off or forced through the apical foramen with disastrous consequences where alveolar abscess did not exist. Neither should drills be forced into a canal closed by calcification, nor into the canal beyond the line of the apical cementum, nor through a constriction which a fine flexible probe cannot enter, nor around a curve sharp enough to be unsafe to pass. A slight pain, of which the patient should be instructed to notify the operator, is experienced when they enter the zone of cementum which composes the end of the root, if its vitality has not been impaired by improper use of arsenic in devitalization of the pulp, or by alveolar abscess. The probe-like points of these drills do not cut, but simply guide the drills and confine them to the line of the canal. They should be gently given a constant slight forward and backward motion in the canal, and treated more as reamers than drills. Unless thus used, the coarse serrations of the head of the drill may fasten in the canal, when the head is liable to be broken off. The occasional quick withdrawal of the drill from the canal during the process of drilling will aid removal of the *débris*.

The depth to which a canal may be enlarged or reamed is regulated by its actual length and previously ascertained condition, and the diameter of the enlargement by the shape and dimensions of the root. The use of these drills is condemned by some operators for reasons properly attributable to their careless or improper employment, but they are indorsed in experienced hands for their adaptability to the work under consideration. They should be frequently sharpened with a suitably shaped Arkansas stone. The shank just back of the head should be large enough to assure strength. The temper should be such that the steel may be bent but not broken, even though the edges of the serrations become sooner dulled. The Palmer root-canal excavators also will be found serviceable to open up a canal and enlarge it in accordance with its original shape.

The reaming of a canal not only simplifies the operation of filling, but also opens up the ends of the tubuli, and facilitates the permeation of the dentine by antiseptic agents, the advantage of which must be admitted when a septic condition is present. Under favorable circumstances the line of the zone of cementum at the end of the root is a safe point to ream to and stop at.

I am aware that some few operators state that they do not ream out root-canals, but claim to treat and fill them as well as those who do. Careful investigation of the subject seems to demonstrate that the majority even of these, in obtaining an entrance to a canal, enlarge the orifice and to some extent really ream out the canal. The reaming, then, is with them only a matter of extent. I also find, as a rule, that in proportion as root-canals are properly—I do not mean excessively—reamed and opened up, so are subsequent operations on them satisfactorily performed.

In the treatment of alveolar abscess, the canal should be enlarged as already described, and the foramen, if possible, opened up with a smooth broach instead of a drill. Drilling through the end of a root or extensively into the cementum at the apex is to be condemned, except when it is desirable to afford immediate relief to the patient in cases of acute abscess. In chronic alveolar abscess the immediate or more prolonged action of agents sealed in the canal for a day or more, for the purpose of disinfection, will usually facilitate the passage of a broach or permit peroxid of hydrogen to be forced through. When this is not the case, a fractional part of a drop of aromatic sulfuric acid, held in position in the end of the canal on a few shreds of cotton for twenty-four hours, will usually effect an opening unless exostosis exists. My objection to attempting to drill through a foramen is that although the main line of the canal may be straight, or nearly so, the extremity of the root to some extent curves in a large proportion of cases, a condition impossible to always determine; and as a sharp-pointed drill has to be used, it will move rather in a straight line than a curve, so that a passage to one side instead of through the foramen is likely to be made (Fig. 4). This leaves the apex in a form not conducive to successful treatment unless a bur is subsequently introduced externally into the region of the abscess, and that part of the apical section of the root removed.

Therapeutic Treatment of the Root-Canals.—Pulpless teeth are presented for treatment in either of the four following conditions:

1. Where a healthy or non-putrescent pulp has been extirpated from the canals.
2. Where on opening into the pulp-chamber it is found empty and dry, with the pulp mummified, or the root-canal calcified, and the root externally in a healthy condition.
3. Where a pulp is found in diseased or putrescent condition.
4. Where alveolar abscess is present, and a septic condition of the canals and dentine exists

In the first and second classes the treatment should be directed to assuring a continuance of the existing aseptic condition, and as immediately as possible filling of the canal; in the third and fourth classes, to bringing about an aseptic condition by disinfection and sterilization, and making certain of its future maintenance, including incidentally the cure of any existing disease of the external membrane or of the alveolus.

In cases of the first and second classes, water and saliva should be excluded from the pulp-chamber and canals during their entire preparation and filling. The instruments should be sterilized, and the broaches, if serrated, had better be new. In the third and fourth classes, exclusion of saliva or water is not necessary in the preliminary work on the canal; water may be freely used until the process of disinfection and sterilization is commenced. Then and thereafter its entrance must be prevented. To this end the rubber-dam should be applied if practicable. When it is not, as frequently occurs with roots and teeth badly affected with cervical decay, other means of keeping out moisture should be resorted to. In such cases, during each interruption in the operation the entrance to the canal should be filled with absorbent cotton saturated with a suitable essential oil or antiseptic fluid, and saliva thus excluded.

After the canal has been properly opened up and its contents removed, it may be washed out with peroxid of hydrogen, and wiped out with absorbent cotton. The next point in the conduct of the operation is to secure as thorough a state of dryness into the pulp-chamber by an ordinary or an A. S. Richmond hot-air syringe, at a temperature higher, as it leaves the nozzle, than is comfortable for the finger. A root-canal dryer, with the end tapered as fine as a broach at the point, is then introduced into the canal. I prefer the form in which the point is made of silver and the bulb portion of copper. As silver possesses remarkable properties as a thermal conductor, the heat is transmitted to the point of the probe very rapidly. The probe being inserted as far as possible up the canal, the patient is directed to raise the hand as a signal should the heat cause pain, when the probe must be moved up and down or withdrawn for a moment. This procedure, following the previous application of the hot air with the syringe, evaporates the moisture and aids the escape of any gases present in the root-canals and the open ends of the tubuli. The point of the root-canal dryer acts as a sterilizer, and may be applied so hot as to carbonize any organic matter which it reaches in the end of the canal, a portion of which can each time be removed on its point. As the silver point can be tapered as small as the finest broach, canal-contents impossible to remove may be reached or rendered inert.

In cases of the third or fourth classes, sepsis being present, the heat is very serviceable, as it aids the escape of gases from the canal and dentine and acts as a germicide. When in this dry and heated condition, the dentine is in the best possible state for the application of antiseptic agents.

The suitability of various antiseptics to the needs in treating tooth-structure, their effectiveness and permanency when so used, singly or in combination, are subjects on which great diversity of opinion exists, and which have of late been made the object of clinical study and scientific investigation and discussion. Many antiseptics in common use being coagulants of albumen, obstruct the dentinal tubuli, and consequently limit or retard diffusibility throughout the dentine. This is the objection to the use of carbolic acid, creasote, and like agents, additionally to which may be named their inefficiency to accomplish in certain conditions the end sought, and as well their eventual absorption from the dentine. Recent investigations seem to give preference to such antiseptics as are non-coagulative in their action. Of this character are the essential oils, many of which, according to Miller, Harlan, and others, possess antiseptic power much greater than has been commonly attributed to them. Acidulated solutions of bichlorid of mercury, peroxid of hydrogen, the new agent sodium peroxid, especially in preliminary treatment, and various preparations of iodin, which exert chemical action and retain antiseptic properties for a great length of time.

The selection of antiseptic agents is important, and is indicated by the conditions presented in a pulpless tooth. Cases in which a healthy pulp has just been extracted, or the canal is aseptic, are different from those with sepsis of dentine or diseased or putrescent pulps. In the first-mentioned condition, with or without antiseptic treatment, favorable results usually follow root-filling, the advantage of a reliable antiseptic agent in the canal being only to better insure the continu-

ance of a state of asepsis. In the second condition the state of the dentine, and consequently the treatment to be effected, are entirely different. We need the action of agents that will not only destroy ptomaines, but exert a chemical action on sulfuretted hydrogen and ethereal, ammoniacal gases, the products of putrefaction, and entirely eliminate them. On this depends the successful treatment of such cases, as the pressure and expansion of these gases are a certain cause for constant peridental inflammation, and so long as they are present in the slightest degree in a canal it is in an unsuitable condition to be closed. Carbolic acid, creasote, or the essential oils, in such a condition exert no chemical action on these gases, merely disguising their odor, though by repeated dressings of cotton saturated with these agents the gases are absorbed by the cotton, and to an extent slowly eliminated. What is required is the action of agents whose elements possess an affinity for these gases, and will immediately decompose them, forming new combinations and entirely destroying their character.

Regarding the use of agents in treatment of septic dentine of pulpless teeth, Dr. W. F. Litch, in a paper published in the *DENTAL COSMOS*, February, 1882, says, "In this respect a careful discrimination must be made between the powers respectively of such antisepsics as carbolic acid, creasote, oil of cloves, oil of thyme, etc., and such other antisepsics as chlorin, bromin, and iodin, which, in addition to their antizymotic power, are true chemical antagonists of those sulfuretted hydrogen compounds of which putrefactive gases are constituted, such gases being immediately decomposed by them; their hydrogen element going either to chlorin, bromin, or iodin, to form respectively hydrochloric, hydrobromic, or hydroiodic acids, the sulfur being in each case precipitated." "An antiseptic agent as carbolic acid cannot be said to be a true disinfectant, in the sense that all the products of putrefaction are decomposed by its presence. No matter how thoroughly the odor of putrefactive gases in a room or in a tooth may be masked or disguised by the characteristic odor of carbolic acid, creasote, oil of cloves, or indeed any antiseptic oil, the gases are none the less present, although their odor is neutralized; the disinfection is only apparent, not real; the further formation of putrefactive gases may be prevented, but the decomposition of those already formed must be accomplished by those chemical agents already cited."

I bring these facts respecting these agents emphatically to your notice, as I am conscious that a large proportion of practitioners at the present time still entirely adhere to and depend on carbolic acid or creasote exclusively for the treatment of the conditions presented in pulpless teeth.

In accordance with these principles, the use of iodin is indicated and preference is given to its use in practice to that of the other agents mentioned. Its effects are best obtained from some one of the preparations now in use,—aristol, for instance, its odor being entirely unobjectionable, in a strong solution in one of the essential oils. In my practice I favor the oils of cloves, cassia, and eucalyptus. I consider the oil of cloves more sedative in action than the others. I make it a point to flood the canal with the solution, thereby to some extent saturating the heated dried dentine as well as the cementum at the

apex. A more effective saturation can be accomplished by again drying and heating the dentine and applying the solution, or by filling the canal with cotton saturated with the solution, hermetically inclosing it and letting it so remain for a day or two.

I do not claim that coagulants, such as creasote or carbolic acid, are entirely non-diffusible in devitalized dentine or cementum, as decomposition or putrefaction effects elementary changes in the contents of the tubuli, but that their action is slow and limited compared with that of the essential oils. They have also the objectionable feature of being irritants, and unsuitable where acute or chronic inflammation of the peridental membranes is present. I wish to mention this forcibly, for there are prominent men in the profession who advocate carbolic acid as the most suitable, and in the treatment of alveolar abscess as the best, remedial agent, declaring with great positiveness that the use of all other agents is useless and a waste of time. The history of the indiscriminate use of carbolic acid and creasote in practice, by others and myself, has convinced me that they are not in all cases and at all times suitable therapeutic agents to use. When a healthy pulp has just been extirpated, and "immediate root-filling" is practiced, the use of carbolic acid, creasote, or solution of chlorid of zinc is best indicated, the condition then presented being entirely different from that where the pulp is diseased or putrescent, or the canal is in a septic state. When a healthy pulp has been removed, its minute fibrous connections with the walls of the canal and the vessels at the apical foramen are severed, and the action of an escharotic antiseptic agent, such as carbolic acid, is in fact then indicated, as it acts as a coagulant and instantly seals up the ends of the tubuli. If "immediate root-filling" is not to be practiced, then the prescription of such agents as the essential oils, with aristol or iodoform, seems more suitable, as by their action a slow but certain mummification of the non-vital organic matter follows. Moreover, the oils possess advantages over the coagulants mentioned in not being miscible in water, this being eliminated, so that by their use the antiseptic action is perpetuated.

From these statements it might be asked, What special advantage is there in the much-discussed method of "immediate root-filling," beyond that of the time gained by the operator? I would answer that in the proper conduct of treatment there is none. A canal with an antiseptic dressing, with the orifice of the canal and cavity hermetically sealed securely with gutta-percha or oxyphosphate of zinc, is free from the danger of inroads of micro-organisms or of the prevention of sepsis for a reasonable interval of time. The disadvantage of immediate root-filling is that, should some fragment of the pulp remain in the extremity of the canal, it fails to receive the benefit accruing from the reapplication of antiseptics, which would better assure inertness by mummification.

In brief, my conclusions are that in cases of pulpless teeth, where an aseptic condition of root-canals and dentine exists and immediate root-filling is to be practiced, the use of coagulants, such as carbolic acid or creasote, alone or in combination with other suitable agents, is permissible, but when sepsis exists their use is contraindicated in favor of non-coagulants; that treatment with such agents should be followed and the filling of the root be temporarily deferred; that if alveolar abscess exist, treatment through the apical

foramen by injection should be restricted to the use of non-coagulants, until disinfection of the dentine is effected.

There is such a thing as over-treatment,—an unnecessarily frequent renewal of antiseptic dressing in root-canals, thereby aggravating or producing irritation of the pericementum at the apex of the root. Such cases may be relieved by washing out the canal with alcohol and applying the alcohol on the dressing, instead of the agents previously employed.

Closure of the Apical Foramen and Filling of the Canal.—The object of root-canal filling is to prevent the entrance of the fluids through the foramen, and avert, in case of the formation of gases, irritation of the periodontal membranes by their pressure or presence.

Respecting this branch of treatment, I might say that there is no difference of opinion as to what ought to be done, but preferences exist as to the method of procedure and the materials to be used. Gutta-percha or oxychlorid of zinc are generally accepted as the most suitable. Either gutta-percha in the form of chloro-gutta-percha, or the oxychlorid of zinc mixed thin, can be pumped or placed in the extreme end of the canal with the aid of a broach or fine-pointed probe. This is one of the advantages that commend the use of these materials. When the chloro-gutta-percha has been placed in the apex, the remainder of the canal can be filled with the prepared cones of solid gutta-percha until no more can be inserted. A current of hot air should then be thrown on the protruding ends of the cones at a temperature sufficient to soften them and warm the dentine, when they should be gently pressed, but not suddenly pushed, up in the canal. A slight twinge of the patient will usually be the signal of their complete impaction in the canal. The solid gutta-percha absorbs what little chloroform was present in the chloro-gutta-percha, and the heat also aids its evaporation, so that the shrinkage so often urged as an objection against the use of chloro-gutta-percha is reduced to a minimum.

An advantage possessed by oxychlorid of zinc over other materials is its antiseptic qualities ; its disadvantage, the difficulty attending its removal from the extremity of the canal should supervening conditions require it. I frequently use it in combination with gutta-percha, filling the extremity and part of the canal with gutta-percha, and then the orifice and pulp-chamber with oxychlorid. Wood and metal shaped to fit the canal are also much used to fill root-canals, but unless a small quantity of chloro-gutta-percha or oxychlorid of zinc is placed in the extremity or on the point used, the entire closure of the canal is doubtful. The use of cotton as a filling in root-canals is to be condemned, unless it is sterilized or iodoformized and saturated with chloro-gutta-percha previous to insertion. Asbestos by some is given preference to cotton. Tin or gold foil is difficult to insert without vacuoles. Paraffin in combination with a small quantity of aristol, as a material to fill root-canals, has been suggested by Dr. Kirk, especially after the use of sodium peroxid,—sodium peroxid being a most active solvent of albuminous matter, in a measure frees the ends of the tubuli or a canal of their organic contents, a condition favorable for the use of paraffin. Paraffin is aseptic and melts at a low temperature, and can with a heated root-canal dryer be flowed into the ends of the tubuli or a minute canal that was not considered safe

to open up. Ordinary gutta-percha should be used to close a foramen when an abscess has just been treated by injecting through it. The length of the canal should be measured with a probe, and gauged with a small perforated disk of rubber-dam slipped upon the instrument. The gutta-percha should then be carried to position on the point, and an allowance made for the displacement of the instrument. As oil of eucalyptus is a solvent of gutta-percha, the application of this oil, alone or in combination with iodoform or aristol, is recommended in the final treatment when chloro-gutta-percha is not used, as better adhesion of the gutta-percha to the walls of the canal is thus obtained. In a case of chronic alveolar abscess, where amputation of the apical section of the root is to be practiced, oxychlorid of zinc makes a most suitable filling.

It is not my intention to discuss the subject of alveolar abscess, more than to say that it matters not what form it may present, treatment primarily should consist in a thorough disinfection of the canal and dentine of the affected root, and finally the adoption of such measures as will maintain a state of asepsis.

I feel that I cannot well close the paper without some comment on the method proclaimed by Dr. Herbst of treating pulps in teeth ordinarily classed as pulpless, and which has of late been given considerable prominence. The idea of this method is to devitalize with cobalt only the section of the pulp in the pulp-chamber, remove it and seal up the portion in the canal, adopting measures during the operation to maintain asepsis, as the pulp will then probably remain inert in case of non-vitality supervening. The object is to simplify and lessen the work on such teeth, and retain some circulation in the dentine from the remaining vital pulp in the roots.

The objections to this method, briefly stated, are :

1. The action of cobalt or arsenic in the devitalization of a pulp is not controllable.

2. Even though the vitality of the pulp left in the root-canals is retained, an atrophied and then a non-vital condition is liable to follow also, as a large percentage of exposed pulps are diseased, and in such cases sepsis will supervene.

3. The method in result is similar to the operation commonly performed in which antiseptic measures are adopted, but lacks thoroughness respecting the treatment of root-canals.

4. Its performance in detail, as described, would require in many instances as much time as the recognized method in practice.

5. Present recognized methods show an exceedingly low percentage of failures, and the practice of Dr. Herbst's method would commence an era of doubt and uncertainty respecting operations on pulpless teeth.

6. The introduction of such a method in the teachings of the schools and elsewhere would have a tendency to encourage a lack of thoroughness in operations on pulpless teeth.

I make this criticism with due deference to the investigations and statements of Dr. Herbst, and respect to the gentlemen in this country who have advocated his method.

Having presented to you my conception of what I consider should be the treatment of pulpless teeth in accordance with correct scientific and rational principles, and as dictated by modern methods of

practice, I might ask the question, Are these described operations always possible of perfect performance? We work at times under great difficulties, in places unseen, and we cannot assert what is unknown. I consider it far preferable to suspend efforts to effect thoroughness in a root-canal than to risk penetrating foramen or wall; better to fail to thoroughly impact the filling than to force it through the foramen into the apical space. The former would be designated a failure; the latter would be a mal-performance. Sound judgment counsels caution, which with knowledge and skill will as a rule insure present and future satisfactory results in these operations.

To the educated, skilled dentist of the present day, few pathological conditions of the teeth are uncontrollable, and in mechanical operations extraordinary results are possible of attainment. Treatment of pulpless teeth in accordance with the principles and methods advocated I believe will be classed among his greatest successes.

